REMARKS

Administrative Overview

The Office action dated November 29, 2005, examined claims 39-58 and 60-83. The Office action rejected claims 39-58 and 60-81 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 5,629,594 (**Jacobus**). Claims 82 and 83 are allowed.

Without acquiescing to any of the arguments or rejections of the Office action, Applicants amend independent claims 39 and 60 as reflected in the Listing of Claims in an effort to advance the prosecution of this case. The amendments of claims 39 and 60 are supported in the originally-filed specification, for example, in the Abstract, lines 5-7, and at page 6, line 28, to page 7, line 26. No new matter is added.

Applicants also amend claims 50 and 73 to correct an inadvertent omission. The amendment of claims 50 and 73 are supported in the original specification, for example, at page 9, lines 25-27; no new matter is added.

Following entry of this paper, claims 39-58 and 60-83 will be pending. Applicants request reconsideration and withdrawal of the rejections, and Applicants request allowance of claims 39-58 and 60-83 in due course.

Discussion

At least in certain embodiments, the invention of the present application provides a more realistic generation of forces arising from interacting with a virtual object. In general, the improved realism results from allowing a user-manipulated haptic interface to penetrate surfaces of the virtual object while forcing a "fiducial object" to remain on the surface of the virtual object, and calculating a force in response to both the haptic interface location and the fiducial object location.

In certain embodiments, this force is set proportional to the distance between the two locations, such that a user experiences increased resistance the further she penetrates into the surface of the virtual object.

The improved realism is explained in the original specification, for example, at page 7, lines 20-26, as follows:

> Forcing the fiducial object to remain on the surface of the virtual object allows for a more realistic generation of the forces arising from interacting with the virtual object. Unlike in the vector field methods, the direction of the force to be applied to the user in real space is unambiguous. The user is not "pulled" through an object when the user should continue to be "pushed" away from the

> object. The method of the present invention is therefore suitable for thin objects and arbitrarily shaped polyhedral objects.

Amended claims 39 and 60 are not anticipated by **Jacobus**

Without acquiescing to any of the arguments or rejections of the Office action, Applicants amend independent method claim 39 and the analogous independent system claim 60 as indicated in the Listing of Claims.

Each of the amended claims 39 and 60 recite, in part [emphasis added], "wherein the haptic interface can penetrate a surface of the virtual object in graphic space", and "wherein the fiducial object location represents a location the haptic interface would occupy if the haptic interface could not penetrate the surface of the virtual object".

Applicants describe "fiducial object location" in the specification, for example, at page 6, line 28, to page 7, line10, a portion of which follows [emphasis added]:

> The fiducial object location represents the location in graphic space at which the haptic interface would be located if the haptic interface could be prevented from penetrating the virtual objects. The fiducial object does not penetrate the surfaces of the virtual objects. ... When the haptic interface penetrates the surface of the virtual object, the fiducial object remains located on the surface of the virtual object.

With regard to claims 39 and 60, the Office action alleges the following:

> **Jacobus** also discloses determining a fiducial object location on the surface of the virtual object and calculating a force to be applied to the user in response to the haptic interface location and the fiducial object location (column 2, lines 55-65).

Applicants respectfully traverse this allegation. The cited portion at column 2, lines 55-65, of **Jacobus** is reproduced below:

> high performance brushless DC motors. A general object of the present invention is to provide a tactile virtual reality in response to a 5 user input. According to the present invention, an electric signal is generated for each of a plurality of degrees of freedom of the user as a function of the user position and orientation in three-dimensional space. At least one virtual reality force field is generated in response to the generated signals. A fourth signal is generated for each degree of freedom as a function of the force field, and a tactile force on the user is generated for each force signal.

In particular, at col. 2, lines 58-60, **Jacobus** states [emphasis added], "an electrical signal is generated for each of a plurality of degrees of freedom of the user as a function of the user position and orientation in three-dimensional space."

Reference to an "orientation" does not teach or suggest the limitation in claims 39 and 60 of a fiducial object location, "wherein the fiducial object location represents a location the haptic interface would occupy if the haptic interface could not penetrate the surface of the virtual object".

Additional comment regarding the failure of other cited portions of **Jacobus** to teach or suggest the limitations of amended claims 39 and 60 are included below (see the section below regarding rejection of dependent claims 44, 61, and 67).

Jacobus does not teach or suggest all of the limitations of amended claim 39 or amended claim 60. Therefore, Applicants respectfully request reconsideration of the rejections of claims 39 and 60, and passage of these claims to allowance in due course.

Dependent claims 40-58 and 61-81 are not anticipated by **Jacobus**

Claims 40-58 and 61-81 each depend directly or indirectly on either independent claim 39 or 60, and as such, each include all the limitations of their respective parent claim. Thus, claims 40-58 and 61-81 are allowable for at least the reasons discussed above with respect to claims 39 and 60. Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejections of dependent claims 40-58 and 61-81 under 35 U.S.C. § 102(e), at least on this basis.

Dependent claims 44, 61, and 67 are not anticipated by **Jacobus**

In addition to the reasons above with respect to independent claims 39 and 60, dependent claims 44, 61, and 67 further distinguish from **Jacobus**. With regard to these claims, the Office action alleges the following:

> Referring to claims 44, 61, and 67, **Jacobus** discloses generating a representation of a virtual object within a computer and computing the fiducial object location, such that the distance between the fiducial object location and the haptic interface location is minimized while maintaining that the fiducial object not pass through the virtual object (column 4, lines 25-45 and column 10, lines 25-45).

Applicants respectfully traverse this allegation. The cited portion of **Jacobus** at column 4, lines 25-45, is reproduced below:

The present invention is a system and method for presenting forces to an operator of a remote device or to a user interacting with a virtual environment in multiple axes simultaneously mediated through a computer 15 controlled interface system. A block diagram of the system is shown in FIG. 2. A user 20 provides a position, velocity, and/or acceleration (to be referred to generally as "force") to the user interface 22. The user interface generates an electrical signal for each of a plurality of degrees of freedom of the user corresponding to the motion of the user interface along, or about, the respective degree of freedom. These electrical signals are fed to a virtual reality force field generator 24 which calculates force field values for a selected force field. These force field values are fed to the force signal generator 26 which generates a force signal for each of the plurality of degrees of freedom of the user as a function of the generated force field. These motion commands are feedback to actuators of the user interface 22 which provide such force to the user interface and thus to the user in contact with the interface device. A flowchart of the method corresponding to this system is shown in FIG. 3 and referred to generally by reference numeral 30.

This excerpt appears to describe generation of an electrical signal corresponding to the motion of a user interface. In particular, at col. 4, lines 32-35, **Jacobus** states [emphasis added], "The user interface generates an electrical signal for each of a plurality of degrees of freedom of the user corresponding to the motion of the user interface along, or about, the respective degree of freedom."

There is no teaching or suggestion here in **Jacobus** that a force is generated based on a "fiducial object location" where, "the distance between the fiducial object location and the haptic interface location is minimized while maintaining that the fiducial object not pass through the virtual object" (compare to claims 44, 61, and 67). Furthermore, there is no teaching in **Jacobus** that "the fiducial object location represents a location the haptic interface would occupy if the haptic interface could not penetrate the surface of the virtual object" (compare to independent claims 39 and 60).

The Office action also cites column 10, lines 25-45 of **Jacobus** in its rejection of claims 44, 61, and 67. **Jacobus** describes "detents" at column 10, lines 17-49, reproduced below:

Detents

Consider trying to implement a "feel" which is similar to a spring loaded ball bearing falling into a dimple. This class of "feel" is a detent. A two dimensional representation of a detent is shown in FIG. 15*a*. Bounding box 220 has a center at coordinates (Xc, Yc) and is defined by

Xc−01<X<Xc+03

Yc−02<Y<Yc+04.

The detent computes and applies a force contribution, Fin/Fout, to the hand controller actuators only if the hand controller joint coordinates, X and Y, are within bounding box 220. If this is true, the force contribution is computed as a function of the distance, D, from the detent center, Xc, Yc. The distance is defined as:

D=Square Root((X−Xc)2+(Y−Yc)**2) [1]**

For cases where D is larger that Rmax, the force contribution, Fin and Fout, are [0,0]. For cases where D is less that R, Four is zero and Fin is computed as a force directed toward the center, Xc, Yc, from the current joint coordinates, X, Y. This computation is as follows:

Fin=[X−Xc Y−Yc]*(−kin*D−velocity*din+Kin).

Where velocity is computed from successive D measurements (in turn, computed from successive joint coordinate values, X, and Y, through equation [1] above), kin is the inner radius, R, spring constant, din is the inner radius velocity damping factor, and Kin is the inner radius status force term.

In this excerpt from **Jacobus**, it appears that a force is calculated as a function of a distance, D, from the detent center (X_c, Y_c). The detent center is a fixed position. The detent center is not illustrative of a "fiducial object location" as recited in independent claims 39 and 60. This is because, for example, the detent center does not, "represent[] a location the haptic interface would occupy if the haptic interface could not penetrate the surface of the virtual object." Furthermore, the detent center is not a fiducial object location where, "the distance between the fiducial object location and the haptic interface location is minimized while maintaining that the fiducial object not pass through the virtual object," as recited in claims 44, 61, and 67.

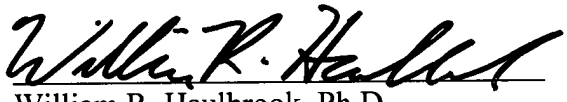
Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejections of dependent claims 44, 61, and 67 under 35 U.S.C. § 102(e), at least on this basis.

Conclusion

Applicants request that the Examiner reconsider and withdraw the standing rejections in light of this Amendment and Response, and that the application be allowed. Applicants respectfully submit that all of claims 39-58 and 60-83 are in condition for allowance.

If the Examiner believes that it would be useful to discuss any aspect of the application by telephone, the undersigned representative cordially invites the Examiner to call at the telephone number given below.

Respectfully submitted,



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